Forward-angle np scattering at 96 MeV and normalization of neutron-induced nuclear reactions

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The np scattering cross section - in particular at 180 degrees (c.m.), which corresponds to proton emission at 0 degrees in the lab - is used to normalize measurements of other neutron-induced cross sections, i.e., it is the primary standard cross section. In addition, it plays an important role in fundamental physics, because it can be used to derive a value of the absolute strength of the strong interaction in the nuclear sector, commonly expressed as the pion-nucleon (pNN) coupling constant. Previously, data from Uppsala covering 74–180 degrees have been published. Since part of the angular distribution was not covered, NN models were used to correct the normalization result for the undetected angular range, resulting in a 2 % uncertainty. If the entire angular range were known, it would have been possible to normalize the data to the total cross section directly by integration. This has motivated the present experiment on forward np scattering (0–84 degrees). Subtraction of data obtained with CH_2 and carbon targets has been used to obtain the np differential cross section. By measuring CH_2 and carbon in the same experiment, the elastic cross section ratio of hydrogen versus carbon can be obtained. Since the elastic cross section of carbon can be determined absolutely by a combination of differential, total and reaction cross section measurements, an independent cross-check of the absolute np cross section can be obtained.

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